Lessons from the Space Shuttle Columbia Recovery Effort

Roger Mellott

Lessons from the Columbia Recovery Effort

An Overview:

On Saturday morning February 1, 2003, the Space Shuttle Columbia broke apart while re-entering earth's atmosphere. Shortly before 8AM CST during normal maneuvers to bring the Shuttle back from orbit, the Columbia transmitted its last message. It was only 16 minutes from its scheduled touchdown at Cape Canaveral, Florida. What NASA officials now know but didn't then was that dangerous hot air was entering its left wing. Flying 200,000 feet above Texas at 12,000 mph, the Shuttle began to disintegrate. Without warning, NASA lost contact with its Shuttle and crew of seven. Emergency officials began getting reports of shuttle debris. Ironically they came from all 50 states and 6 neighboring countries. NASA faced a monumental challenge. What had happened to their vehicle and where were their astronauts? With the help of CNN and other networks, data from the weather channel and confirmed debris reports from citizens in east Texas, the real scope of this disaster began to take shape. Unlike plane disasters that typically involve one concentrated crash site, this disaster extended for hundreds of miles. Within two weeks, an accurate debris field became clear. The Columbia had come to rest on what proved to be a straight line stretching 220 miles from Fort Worth, Texas on the west to Fort Polk, Louisiana to the east.

How do you organize and implement an operation of this magnitude? Within an hour of the Columbia's last communication, the recovery was formally under way. In the three months that followed, NASA teamed with FEMA, EPA, the FBI and the US and Texas Forest Services to coordinate the most extensive search ever undertaken. Finding the crew became their first priority. Ground, air and water search teams endured cold, wet, winter weather and extreme circumstances. The woods of east Texas created a tremendous challenge. What is the best way to effectively search over two million acres of thick pine forests, bamboo groves, impassable briars and snake infested swamps? A command center was needed. Lufkin, the largest city near the debris field was chosen. It had an airport, rental cars, hotel space, restaurants and an available civic center. There were many different immediate problems. The Shuttle was in backyards, church and school parking lots and on public roads. Everything that fell from the sky was treated as hazardous material. Protection consumed local officials who were quickly overwhelmed. Texas state troopers and the National Guard were immediately sent to help. Unfortunately, shortly after they were deployed, an upgraded terrorist alert recalled all of them. NASA had already lost its primary search asset. What was the next step? It was a key leadership moment.

Hundreds of state, federal and local agencies coupled with business and volunteer groups responded. First response emergency teams and local forest service workers searched day and night until the astronauts were found. It took almost two weeks. The shuttle was a more complex task that required a more organized approach. First, NASA had to figure out how to locate parts and deal with whatever was hazardous. Then people had to tag each part and prepare them to be shipped to Kennedy Space Center. The forest service provided the workforce that NASA needed, firefighters. With fire season months away, they were able to convert their formal ICS fire fighting system to recover the shuttle. Four base camps were established. These were large tent cities of fire fighters working three-week shifts. Broken into teams of twenty people, line

searches were conducted spreading people three feet apart and systematically walking what turned out to be 680,000 acres of farmland and woods. A grid system was set up to help manage the search. With the help of elaborate maps and GPS, fire fighting ICS teams searched one grid at a time. By the end of April, 17,000 firefighters, many of whom were Native Americans, successfully recovered over 87,000 pieces of the Shuttle. This represented almost 40 % of the Columbia including the keys to what went wrong. The recovery exceeded everyone's expectations. It did not come without a cost however. Two helicopter pilots were lost in the air search. The slow rural pace of life in east Texas changed because of a huge workforce of outsiders. It was emotional, overwhelming and all encompassing. When it was over, FEMA paid out over 300 million dollars, the cost of the entire operation.

In spite of the tragedy that brought thousands of people together, the recovery effort proved to be an unexpected positive, even life-changing experience for many. It was an extraordinary effort in leadership and teaming. It demonstrated how organizational capability is gained from combining forces and talents of different groups. It showed how belief and buy in positively impact problem solving and decision-making. Valuable insights were gained on ways to get results, to build relationships and develop leaders. It was an experience from which much was gained and much can be taught. There were many amazing pieces of this situation. No one was hurt in spite of all of the thousands of pieces of shuttle debris that rained down on Texas and Louisiana at speeds of almost 1200 mph. Two weeks before the accident took place, the woods of east Texas were flooded with hunters. If this tragedy happened two weeks earlier, countless hunters would have been at risk. If it happened two minutes earlier, the shuttle would have rained down over the heavily populated area of Dallas/Ft Worth. In spite of how horrible things were, things could have been much worse.

I was chartered by Bill Readdy Deputy Administrator, Office of Space Flight, NASA Headquarters to conduct formal debriefings of key leaders involved in the recovery effort. Teamed with Cheryl McPhillips, a senior engineer from Kennedy Space Center, we spent two months living in east Texas learning this remarkable story. Our primary job was learning how this effort evolved, who the players were and how the operation ran. We got to search for the shuttle with a Hopi Indian team from Arizona. It gave us a first hand experience of how difficult the woods were and how small much of the shuttle parts were. We then were teamed with Rebecca Wright, an oral historian from Houston closely tied to NASA. For almost two months, we conducted 50 interviews we called oral histories. These lasted anywhere from one to four hours and focused on the insights and reflections of the recovery leadership from the major agencies involved. Our goal was to understand what happened, to become part of their experience and to withdraw from their stories, the lessons of this recovery. From these interviews, Cheryl and I saw a pattern of lessons emerge. This paper represents our conclusions. Conducted from mid March to May of 2003, interviews from key personnel in NASA, FEMA, EPA, FBI, Forest Services and local officials critical to this recovery effort provided the insight behind these lesson choices.

Referred to as our White Paper, these lessons are broken down into three sections:

I. The list of eleven primary lessons.

II. The detailed description of these eleven lessons and suggestions to NASA in how to implement them into its mainstream.

III. The collection of quotes taken directly from the oral histories. These quotes represent lessons and insights offered by key players and lead agencies of the recovery effort.

Although written for NASA's benefit, it is our hope that these lessons have relevance to other organizations, especially in the development of solution based thinking, high performance teams and the sound decisive leadership they depend on.

Roger Mellott; June 2003

I. Lessons from the Columbia Recovery Effort

1. Effective use of Human Capital

NASA's success in the Columbia recovery effort can be attributed to its people in decision-making positions and the people who surrounded them. The skill and determination of people throughout the recovery was impressive. However, the key to success was the production and innovation that came from freeing people up to fully utilize their capabilities.

2. Belief in the Mission

Equally important to the success of this recovery effort was that everyone believed in and worked towards the goals of its mission. The "buy in" was universal, providing a unified workforce of extreme capability. With this shared vision as a source of fuel, people gained the energy to sustain the creative tension and continuous learning NASA needed.

3. Decisive (Operational) Leadership

It was the ability of leadership to make critical decisions with limited information and to do this with great regularity that made a significant difference at all levels of this effort. With a focus on solutions, leadership looked forward instead of back. There attention was on the learning and decisions that were needed, instead of where blame could be placed. Operational experience was invaluable, especially in Lufkin where the command center was organized.

4. Low Ego

The highest contributors were people who left their egos at home. The grief and extreme sense of loss felt by everyone was a humbling factor that greatly contributed to this.

5. The "Step Up" Factor

High performance organizations depend on discretionary effort. This productive voluntary extra effort is referred to as "stepping up". Throughout the recovery effort, people stepped up and took initiative beyond their current experience or expertise. It was this commitment to mission and to doing whatever mission success demanded that motivated the productivity and sustained performance NASA needed.

6. Healthy Dialogue and Debate

Successful teams and organizations depend on their ability to communicate differences. This requires informed people to speak their minds freely and to listen to the open dialogue of others. These are the skills that ensure that the truth gets spoken and that different perspectives get heard. Known as healthy dialogue and debate, this open communication proved invaluable as NASA prepared for its earliest press conferences and congressional hearings. In unforgiving situations like these when careful thought must be given to what is said, sound dialogue is also needed. As critical tools, healthy dialogue and debate elevates understanding through the communication of differences. Through this understanding, conflicts get resolved. Senior managers throughout this recovery effort depended on sound dialogue and healthy debate to improve strategic thinking, to solve complex problems and to build diverse head strong teams.

7. Team Learning

Team learning uses the collective energies of a team to solve difficult problems. Acting as a unified force, teams of diverse people, sharing a commitment to a single mission, achieve extraordinary results. Motivated by this shared purpose, they compliment each other's strengths. They function as a whole, headed in one direction with a synergy that strengthens power and capability. Throughout this effort, individual preferences on how to run this operation gave way to team learning and decision-making. Much like a group of athletes all in sync at the same time, the Columbia leadership experienced a "zone" of performance. In it, they became a powerful and innovative learning force aligned to tackle the challenges of the recovery.

8. Information Management

The efficiency of an operation depends on how well people or different groups of people manage information. Collecting accurate data and being able to share this data across groups became a problem during this effort. Differences in GIS tools and data bases needs corrected to improve future operations, especially complex ones. Finding ways to improve meetings is also needed. Since all organizations depend on meetings to share information, making sure these are beneficial, problem focused and value added is critical. The tendency is to schedule too many meetings, to share too much information and to mismanage the time and structure effective information management requires. In this effort, daily meetings although useful became problems when they were held all day, when they ran too late into the night and when there was information overload. Face to face meetings were also more effective than telecoms.

9. Structure

Structure played an important role in gaining control over the chaos of the recovery. Once FEMA asserted their role as lead agency, meetings were structured and routinely held, providing intelligence and direction to the operation. When the Incident Command Structure (ICS) was implemented at the end of the second week, great organization took over the Base camp workforce and added extreme efficiency and structure to the Shuttle search.

10. Strong Positive Relationships

Strong, positive relationships between people and organizations contributed to this operation working "seamlessly", a Lufkin reference of how well people worked together. Having close working relationships became a core value that added efficiency and capability. Positive relationships improve communication, organization, innovation and solution based thinking. They also buffer burnout and exhaustion by adding critical support. This was especially important because of the long emotionally draining workloads and extended time away from home.

11. Energy Management

Energy management is a conscious attempt to either conserve energy or replenish it. Although people shared a connection during the recovery effort that boosted energy, the on going demands of the first month proved to be extremely depleting. This depletion increased the risks of burnout, exhaustion, illness, arguments and mistakes. Smart health care behavior such as getting enough sleep and taking needed time off compensate for extreme work demands by replenishing energy. As the effort progressed, health care and energy management improved. NASA's rotation of personnel helped. However, the greatest success in energy management was when Space Flight Awareness started using astronaut guest speakers to boost the morale of forest service walkers. These evening sessions took over a month to begin but were invaluable rewards of energy. As a lesson of this exercise, effective ways of boosting morale and replenishing energy need to be studied and implemented throughout NASA.

II: A Closer, More In Depth Look

This is the more detailed report on the eleven lessons with suggestions on ways NASA can integrate these lessons into the every day culture of the agency.

1. Effective Use of Human Capital

NASA's success in the Columbia recovery effort can be attributed to its people in decision-making positions and the people who surrounded them. The skill and determination of people throughout the recovery was impressive. However, the key to success was the production and innovation that came from freeing people up to fully utilize their capabilities.

Throughout the Columbia recovery, the most important asset was people. Critical decisions were made with little or no information and difficult problems were solved with limited time and unknown resources. It was the conviction of the people involved combined with their resourcefulness and focus that made the difference. Whether it was senior leadership from NASA Headquarters, senior management at Lufkin and Barksdale or the key people from all levels of various NASA centers and programs, people showed up and excelled. In every way, it was the people that made the Columbia Recovery Effort a success. However, its success wasn't automatic. People succeeded because they were freed to excel, because they were held accountable by supportive leadership and because they were personally committed to belonging to a team that demanded extraordinary sacrifice and results.

Having qualified people is always critical to success but using these people in ways that maximize their capabilities is the key to high performance organizations. Throughout this effort, people were "thrown" into situations of need. They did whatever it took. In Lufkin, the leadership worked to sort out and understand who was in charge, to assess the scope of the problem, what resources were needed and best way to obtain them. They established and implemented the priorities of the mission, set up the organization and found the best way to use all of the people they had. Sometimes that meant staying out of the way or doing little things like making coffee, cleaning bathrooms or helping with office supplies. Very skilled people arrived willing to do menial tasks, accepting jobs that some might think was beneath their rank or skill. As organization increased, they assumed more responsibility. The workforce confronted each challenge head on and converted roadblocks into opportunities for learning. This commitment will be needed in NASA's safe return to flight. It will also be needed in completing the International Space Station, in solving the technical problems related to advanced propulsion systems and next generation vehicles and in developing the young talent of the agency. The challenge will be finding ways to keep the bar raised and the "step up factor" high without having the emotional intensity of a lost shuttle to motivate it.

Future success depends on meeting this challenge. In order to do so, NASA will have to lean on its people in the trenches. These were the worker bees in the recovery, people who worked tirelessly solving problems and providing the support this effort demanded. The agency saw that when people were given a chance to make a difference, they made one. People throughout the recovery excelled at making things happen because they were expected to do just that. NASA

must find ways to sustain this expectation and more effectively utilize the people in non-management, non-leadership positions. It was this working force that was so significant at Lufkin, at each of the four Base camps, at Carswell and Barksdale, in the hangers identifying Shuttle parts and in the woods walking with the searchers. People such as Owen Johnson (MSFC, IT), Bradley Waite (MSFC, security), Jerry Schumann (KSC, safety) and Bruce Davis (Stennis, GIS data mgt) were a few examples of NASA's best foot soldiers. Many people gave great service to the agency including groups like space flight awareness. However, no one gave more than the volunteers and local people of east Texas. The sacrifice they made to the agency was beyond compare. Finding ways to cultivate the human spirit and human resources NASA gained so much from needs to be pursued.

Throughout the recovery, great choices were made at putting the right people in the necessary places, and then giving them the freedom to use their strengths, skills, gifts and talents. They became "the right people" because of "who" they were as people not "what" job they did or the title they held pre-accident. There was nothing random about why this effort was successful. Good people showed up and produced. Showing up was the easy part. The challenge was figuring out what to do, finding ways to contribute, to meet a need and to add value in spite of the long hours, work overload and emotional stress.

NASA learned a lot about the talent they had to draw from. They also learned that talent and leadership is not automatic. It needs developed. Not everyone sent to east Texas had the skills or attitude to handle the stress needed to perform under the limitations they faced. For that reason, this effort proved to be an excellent learning tool. It forced people to go beyond their normal boundaries of thought and effort. It separated those willing to step up from those preferring to stay back. It proved that when faced with extraordinary challenges, we'll see extraordinary results and we did. This tragedy was something NASA never dreamed of. It evolved into something NASA needed, a way to add depth and breadth to future capability.

Recovering a shuttle scattered over several thousand square miles of woods required more than intelligence. They succeeded because of situational awareness, keen intuition, faith, chutzpah and the desire that fuels extreme innovation and commitment. The success of this recovery effort went beyond the agencies goal of recovering all seven astronauts, returning them home and finding as much of the shuttle as humanly possible. This was an experience that changed people. People fortunate enough to participate in it shared a life altering event. The profound sadness of February first turned into a cause and calling that everyone wanted to answer. A very bad situation transformed many people and provided a useful and unexpected learning experience that turned out to be positive and life changing. The trick for NASA now is to use this experience to go beyond return to flight and into the mission of exploration. The agency's greatest strength is its people. It's time to grow this workforce, free up their talents, provide real opportunities for learning and give people a chance to make a difference.

2. Belief in the Mission

Equally important to the success of this recovery effort was that everyone believed in and worked towards the goals of its mission. The "buy in" was universal, providing a unified workforce of extreme capability. With this shared vision as a source of fuel, people gained the energy to sustain the creative tension and continuous learning NASA needed.

Although specific differences existed between the mission of Headquarters and the missions of Lufkin and Hemphill, the priorities were compatible. They all shared a common vision to work in unison towards agreed upon goals. NASA committed in earnest to finding whatever went wrong, fixing whatever was required and doing whatever it took to fly safely again. The agency was unified by this collective purpose. The recovery and reconstruction efforts were critical to solving the problem of what went wrong. The fact that people committed to these efforts the way they did added to the performance NASA benefited from. This commitment was motivated by a strong belief in what people were doing and why. This same belief will be needed to correctly fix the problems tied to this disaster before returning to flight.

Future success in NASA depends on diverse groups and programs working together as one agency with compatible priorities. Turf battles need to be replaced with a strategic wisdom, a large scale shared vision that provides understanding to differences in priorities. The recovery effort united many different groups, groups that need to stay united. Throughout, people went beyond personal interests and territorial boundaries because they believed in what they were doing. There was a sense of urgency that added to the feeling of importance people shared. The mission to recover crew and shuttle became personal. This belief and emotional buy in motivated great sacrifice and commitment that helped people endure the demands of the recovery. NASA's senior leadership must continue to define the agencies sense of purpose and direction throughout the return to flight and beyond. Only through true emotional buy-in can NASA hope to bind people, programs and centers into the goal of "One NASA". It will depend on strong leadership and a clear mission to do what the Columbia tragedy did, unify people through a cause. This cause must have a purpose that takes people beyond the motivation of recognition or gain. It must have the heart and human spirit found in east Texas. With these ingredients, NASA can only excel.

3. Decisive (Operational) Leadership

It was the ability of leadership to make critical decisions with limited information and to do this with great regularity that made a significant difference at all levels of this effort. With a focus on solutions, leadership looked forward and not back, concentrating on the learning and decisions that were needed, instead of where blame could be placed. Operational experience was invaluable, especially in Lufkin where the command center was organized.

From day one of the recovery, the leadership of NASA provided the guidance and inspiration the agency (and country) sorely needed. With great heart and courage, key leaders responded to this tragic loss with openness and honesty, a position that was not obvious during the Challenger loss 17 years earlier. Those people close enough to witness the decision-making process saw how decisions were made and how outcomes that appeared easy and automatic evolved from well thought out strategies, often full of raw emotion. One of the best examples was the "find it, fix it and fly again" mantra born after the first emotional meeting Sean O'Keefe and Bill Readdy had

with the astronaut families. This decision was a blend of commonsense and keen vision that expressed genuine concern as well as the future of human space flight. This mantra was not "thought up" to sway the media. It was intuitively chosen to help the agency heal, to honor the profound sacrifice of the astronauts and to keep momentum moving forward in a constructive direction. Great leadership has to trust its instincts along with the data it uses to manage decisions. These are the instincts leaders learn to develop and trust especially when time critical decisions are needed. During the early phases of the Columbia recovery, decisions were made with limited or no information available. It takes decisive confidence and intuition to counter the emotion and confusion they faced.

Many key leadership decisions changed the course of events in this incident. None of these were more significant than the revised contingency plan. During his first day as Administrator, Sean O'Keefe asked to see NASA's contingency plan. It was benchmarked against a contingency plan used by the Navy, making sure it was as strong as NASA needed it to be. Sean's desire to upgrade and strengthen the agency's contingency plan was a classic example of how experience and intuition impact strategic thinking. After the Navy's Submarine Reactor Group provided suggestions on how to improve the plan, it was fully simulated less than three months before the Columbia accident. This was the plan implemented at 9:16 AM when the Columbia failed to return home. What made Sean think to request contingency upgrades when he took office? Where does this instinct and intuition come from? Understanding this and then developing it is a key to future leadership development especially in cultures that are data managed and data driven.

The vision it takes to lead is often a vision born from experience and intuition. In cultures such as NASA who find them selves constantly working in overtime situations fighting "fires of the day", there is often limited time to develop the skill of big vision thinking. It's why leadership depends on the support and balance of their advisors to help off load issues and compensate for this. NASA's senior leadership with the help of many advisors used their experience, their knowledge and internal instincts to guide the agency through the minefield of unknowns early on in this incident. Now it's important to go back and capture what was learned: what was successful and why, what needs to be improved, perhaps changed and how can this be used to grow future decision makers? Experiences like this must be used to grow the vision of its leaders as well as their confidence and decision making instincts. These are the lessons that give NASA an opportunity to convert the understanding gained from the Columbia recovery effort into true wisdom, a trait all organizations direly need and depend on.

NASA's leadership has to use this wisdom to grow its next generation of leaders. The future of the agency depends on the choices they make. Leadership is a cultivated skill but only in people born with a certain talent and potential. Not all people are suited for the challenges and skills great leadership demands and depends on. In NASA, the pathway to SES promotion has required true technical experts to move into management even if they lacked the skills or desire to manage. This system needs to be reconsidered because it forces people into management for reasons of promotion instead of interest or capability. When leadership is graduated from a system that is not based on true merit or skill, the agency pays a dear price. Smart choices must be made about who its leaders will be and how they will be trained. This will require developing a pool of truly qualified candidates. Growing this "bench" of talent must be an agency priority. Perhaps having parallel paths for promotions, management paths and technical paths, would help.

There is no substitute for making wise leadership choices. There were many examples of this in the recovery effort. This effort proved to be an exceptional experience in cultivating talent and showing off some extraordinary people. Some of these people were people placed in leadership

positions. Many more were the people who followed these leaders. To be successful, NASA needed both. To stay successful, NASA will need both as well.

Becoming "One NASA" and effectively rebounding from this accident will require the humanness of the agency to be in line with its technical prowess. It was this combination that proved so successful in east Texas as well as Washington. It was the combination of real people doing real work that converted the Columbia tragedy into a deeply meaningful event. Abraham Lincoln said the real test of a person is not in how they handle adversity but in how they handle power. The power effectively used during the recovery was a real credit to the people granted this power. The trick is moving this capability into normal agency life. There are no shortcuts. Leaders must look within, look around, look ahead and look above. NASA's time is now. The agency must learn from the Columbia, model the attitudes of its best performers and use its lessons to improve.

4. Low Ego

The highest contributors were people who left their egos at home. The grief and extreme sense of loss felt by everyone was a humbling factor that greatly contributed to this.

Mark Stanford of the Texas Forest Service came to Lufkin and provided the best example of what low ego leadership looked like and why it's so important. His style and attitude throughout was invaluable to the successful outcome of this effort. He came with the knowledge and experience to implement the Incident Command Structure (ICS), a proven system used to fight forest fires with an experienced self-sustained workforce. Initially ICS was considered un-necessary because the National Guard and state police were available and being used to search for crew and shuttle debris. Mark's early planning and organization suggestions were ignored. In spite of this rejection, he stayed engaged and involved. He refused to react with the hurt or anger typically found inside of ego. He refused to personalize the fact that nobody supported the real benefits of ICS beyond the workforce it offered.

It was what Mark did in the meantime that was so extraordinary. He took the rejection of ICS and instructed his team to find other ways to help. His goal was to wait until people were ready for ICS. Timing is so important and requires the patience high ego rarely offers. Staying involved and supportive, in small but useful ways, required great confidence on Mark's part. Between the initial rejection and eventual acceptance of his ideas and expertise, he took care of office supplies and fax needs. From being ignored to being extremely useful, he showed everyone the worth of keeping ego out of the way. His lack of ego enabled him to genuinely contribute until the heightened security alert forced the National Guard and state police to leave. By the end of the second week, ICS was fully implemented and given credit for much of the recovery effort success. During those first chaotic two weeks, without an ego to protect, he was able to remain flexible, patient and value added concentrating on what was needed not on how he felt. He put it best during his oral history; "Being right is always less important than doing right."

Although it's hard to teach people this trait, future leadership needs to become aware of positive examples of low ego styles and behaviors. Hopefully, the lack of ego Mark Stanford demonstrated can be modeled within NASA. As ego shrinks, there is a willingness to learn and make a difference no matter what. There were many examples of this throughout east Texas. People who held important positions back home who came willing to do anything and everything. They were grateful to be there and glad to be involved. Small jobs were all part of the system of

work that needed to be completed. The ego, typically associated with power, control and status was rarely visible. This void was of immense importance because ego compromises efficiency and performance. Overcoming the negative side effects of ego will be one of NASA's great challenges. People must see beyond their own lens, beyond their own program and their own priorities. To be successful, the true priorities of the agency must become the priorities of all of its leadership and all of its membership. This is a complex task especially since normal business does not have the emotion that brought people together on these recovery teams. Promoting people who perform without their egos interfering will be necessary to reinforce low ego as a value and true leadership behavior.

5. The "Step up" factor

High performance organizations depend on discretionary effort. This productive voluntary extra effort is referred to as "stepping up". Throughout the recovery, people stepped up and took initiative beyond their current experience or expertise. It was this commitment to mission success and to doing whatever mission success demanded that motivated the production and performance needed to help NASA and its partners approach a situation of this magnitude and meet the everyday challenges it presented.

"We got the job done because very intelligent people at the lowest level (stepped up) and did it". This observation shared by shuttle commander Scott Kelly about his experience in Hemphill, was repeated over and over again by people throughout the recovery effort. The success in finding all seven astronauts and enough of the shuttle to understand what happened was largely due to this "step up" factor. It is high performance behavior motivated by an individual's decision to act empowered. Empowerment generated the innovation and determination behind the creative problem solving witnessed everyday during the recovery. Although organizations can give people the opportunity to be empowered, it is the individual stepping up and taking advantage of this opportunity that makes empowerment happen. It is not something organizations can make happen. They can support it, free people up to choose it and of course prevent it from happening but in the end, it is the individual that has the power to be empowered or not.

NASA's leadership needs to continue encouraging step up behavior throughout the agency. It needs to model empowered behavior and do everything possible to free up employees committed to it. The discretionary effort shared throughout the recovery needs to be shared inside and across program boundaries. Rewarding the best examples of how stepping up works will help. People need to know what is expected of them, how they can do more, when they are doing great work, what boundaries need to be respected and when stepping back or down is as important as stepping up. Great performance needs great balance. There needs to be an awareness of when and how initiative helps and when it doesn't. When motivated by strong beliefs and mission objectives, not personal gain or ego, stepping up is a huge asset that takes the potential of an organization into true skill and capability.

6. Healthy Dialogue and Debate

Agencies like NASA improve with open dialogue and healthy debate between informed people. This provides the insight needed to understand critical differences in data and points of

view. These tools are used to improve communication and elevate the understanding gained from controlled conflict. Senior managers throughout this recovery effort depended on sound dialogue and healthy debate to improve strategic thinking, planning and implementation. This was especially evident among senior leadership responsible for the first press conference.

Understanding is elevated when people are free to speak their minds. Setting the stage for this takes a special level of trust and openness that must be developed and grown. This open form of communication is essential to the success of NASA especially as the agency responds to the investigation board and focuses on return to flight. During the Columbia recovery effort, people had to speak their minds freely and openly without the benefit of pre-existing relationships and trust. Trust was earned. People learned to speak the truth and to listen to the differences of opinions that emerged. These differences were used to solve the complexity of problems they faced. Rarely did one right answer exist. Listening to differences in opinions with a willingness to look through the lens of how different conclusions were reached serves effective communication. This is dialogue for the sole purpose of gaining understanding.

The goal is to gain understanding and then to "grow thought". It is a combination of speaking the truth and learning to trust the need for assertiveness along with listening to different points of view. Conflict, contrary to popular belief, is not a problem and should not be avoided. Great leaders and the organizations do not benefit from the absence of conflict. Conflict is essential in helping people notice more and in pushing productivity, both key ingredients to growing the wisdom and future talent of the agency. In the quest for becoming better at learning, at responding to change and at improving the business of space, there is no substitute for proven communication skills. These are skills most leaders assume they possess. Unfortunately, they rarely exist to the extent to which they are needed. Many managers grow up in organizations or programs in which quiet disagreement is the norm, when false agreement is safer than useful conflict and when speaking the truth carries significant risk. In these cases, when compliance and caution is valued over honesty, mid to low level managers communicate what they "think" is wanted. This contrived openness interferes with the integrity of an organization as well as the information senior managers and leaders need to make good decisions. Sound strategic thought is born from truthful dialogue and discussion, not illusions, assumptions or half-truths.

During the first several hours at Kennedy Space Center on February first, healthy dialogue and debate was critical in shaping several key public decisions. This was one of many demonstrations during the recovery effort when there was no substitute for doing what was right, for saying what was needed and trusting that people would speak the truth. There was no room for "looking good" or "thinking safe". The decisions that needed to be made depended on sound thinking and open dialogue.

NASA is served by learning how to improve its communication skills. This recommendation is not made because of an existing inefficiency but because great communication makes a significant difference in how effective, efficient and productive organizations are. It begins with sound listening, a practice which takes a certain amount of focus and discipline. Most people listen with the intent of responding. Great communication puts the focus on listening to what someone else is saying and then learning with genuine interest in why. There is no need to agree or disagree, to sway opinion or choose sides. Those are all parts of discussion and debate. Dialogue is a listening strategy that ensures that learning occurs. Discussion takes it further.

It would help NASA's senior leaders to master the art of disagreeing. This could be taught in structured communication forums. These structured sessions are designed for the purpose of growing thought and resolving conflicts. Conflict is used as a tool. In these forums with a

facilitator or referee, a specific topic or issue is dialogued, discussed and debated. Hot spots and sticky issues are the best ones to address. Forum topics might include: Is the FRR set up properly to maximize honest sharing of flight readiness? Is SFOC the best contract structure for the human space business? How does the agency improve the relationship with and accountability between its programs and prime contractors? Each session focuses on one topic. The forums are designed to keep disagreement and debate constructive and useful, similar to the 'war room' strategy used by the military. When used properly, healthy dialogue and debate help the agency expands its thinking. The trick is keeping conflict from getting personal. The goal is using differences to add vision, perspective and ultimately, conviction behind decisions.

7. Team Learning

Team learning uses the collective energies of a team to solve difficult problems. Acting as a unified force, teams of diverse people share a commitment to a single mission. Motivated by this shared purpose, they compliment each other's strengths. They function as a whole, headed in one direction with a synergy that strengthens their power and capability. Throughout this effort, individual preferences on how to run this operation gave way to team learning and decision-making. Much like a group of athletes all in sync at the same time, the Columbia leadership experienced a "zone" of performance. In it, they became a powerful and innovative learning force aligned to tackle the challenges of the recovery.

There were many examples of team learning during the recovery, but two were especially notable. The first began on the runway at Kennedy Space Center as Sean O'Keefe, Bill Readdy and Paul Pastorek waited with the crew families for the Columbia to land. As soon as the reality of the situation sunk in, a pre-existing relationship between these three men quickly grew into a new level of synergy. The team learning they shared carried them through the intensity of the first day, the unique challenges of the first two weeks and through the three-month east Texas effort.

In team learning change is a constant so the relationships that share this experience have to remain flexible and open or the team learning stops. It is a dynamic situation that requires a lot of balance. There needs to be a flow between information coming in and information going out, between learning and sharing, between being grounded and being 'out there', being available to everyone and being away from everyone. It is an intense experience that either facilitates people stepping up or overwhelms and contributes to people stepping away.

The second prime example of NASA's involvement in team learning was at Lufkin. The command center inside the civic center was often described as an ant nest or beehive of extreme activity. To an outside observer it looked and felt chaotic. To those on the inside, it had an order that made sense, a way it worked and a synergy they shared. This was classic team learning. There was no design, no decision for how it happened or initial structure to hold it together. Born from the will of the people who shared this experience, the team replaced individual ego for group function. The differences and conflicts were worked out without losing the commitment that kept the group in tact. It was why Wayne Fairly from FEMA said, "This was the first disaster in his 21 years that nobody wants to leave." and why Jim Wetherbee as the lead astronaut said, "I got more satisfaction from my two weeks in Lufkin than six flown missions, five of which I commanded." Team learning often creates experiences that become unexplainable, unforgettable and life changing.

NASA needs to do whatever it can to foster future new examples of team learning. By putting people in new opportunities to learn, the chances of motivating an opportunity for team learning increases. NASA's emphasis on encouraging people to work at different centers, experience different programs and people from different backgrounds will prove to help in this regard. However, these exchanges must be real learning opportunities and not exercises in checking a box.

Team learning must become part of the agencies culture. It takes more than team membership for it to happen. The alignment team learning depends on requires people on a team to head in one primary direction. In order for this to happen, mistrust has to give way to real trust and the fears that keep people apart get replaced with the desire that brings them together. Team learning happens when membership on a team transcends into something extraordinary and groups of individuals become seamless, like the group experienced in Lufkin.

The human spirit witnessed in east Texas was a large-scale version of team learning, when people sacrificed individual needs for the good of the whole. This was a display of ordinary people being anything but ordinary and how caring for others define our most powerful gift. An entire area committed to helping NASA because of their love of the space program, their love of God and of their country. This was team learning spurned by faith, patriotic duty and a need to serve that should remind NASA of its powerful connection to everyday people. Flying again is how the agency honors the crew of the Columbia. It also honors the commitment of people like those in east Texas.

8. Information Management

How organizations manage information is key to efficient outcomes. Collecting accurate data and being able to share this data with other groups became a problem during this effort. This needs to be corrected for future complex responses. Daily meetings and briefing were very useful but became problems when they were held all day, when they ran too late into the night and when there was information overload. Making meetings efficient and value added is critical.

Persistent information processing, data management, and communication problems plagued the recovery effort. Chronic problems persisted with merging multiple incompatible (GIS) databases. GIS or Geographic Information Systems organize, separate and help make sense of large quantities of information. Unfortunately, FEMA and NASA did not have the same systems. Major agencies wanted to use their own database systems because it gave them control over their own information. This added to the confusion and redundancy of data inputs. On day one for instance, 4500 different data entries were entered for what turned out to be 1500 shuttle parts. The database was already off by 3000. Many of these errors were caused by differences in Global Positioning System (GPS) equipment as well as inconsistent GPS operations (using different datum's and not allowing the GPS receiver to acquire satellite). Future operations would be served by advance decisions on compatible systems that can serve the diverse needs of everyone so the next disaster operation can begin with information management in sync. NASA can offer FEMA and Homeland Security useful suggestions on ways to improve the database issue, at the very least how to have a system with true inner operability so diverse participants have common systems that can communicate large and complex databases.

Communications were also limited due to remote rural sites. The lack of towers interfered with cell phone use and no facility was prepared for the phone line and computer needs of an operation

this size. Other communication issues involved the need to keep meetings as short as possible and to the point. During the recovery, meetings became a problem because they ran all day long, sometimes too much information was shared and some meetings ran too late. The goal of information management is to solve problems not to add to the stress of long exhausting days. Although many meetings were efficient, this is an area that needs more attention.

9. Structure

Structure played an invaluable role in how NASA gained control over the chaos of the recovery. Once FEMA asserted their role as lead agency, meetings were structured and routinely held, providing intelligence and direction to the operation. When the Incident Command Structure (ICS) was implemented at the end of the second week, great organization took over the Base camp workforce and added extreme efficiency and structure to the Shuttle search.

Structure added consistency and discipline to the recovery effort. This began with structured meetings and telecons between senior leadership from all key agencies in Washington and the leaders at Barksdale. Eventually it included Lufkin, gradually extending to all Base sites. It took three days before all key players knew who was in charge and what the goals of the mission were. Although FEMA knew this immediately, a lack of organization and structure kept this from being effectively and immediately shared with others. A structured meeting to announce this and introduce all other leadership present would have helped. By day three a routine was organized for sharing information updates, operational needs and logistic concerns. Structure provided the backbone this early organization evolved from and served the assertiveness the earliest operation lacked.

Structure was critical in the task of defining the debris field. On the morning of the accident, the debris field was unknown because the shuttle did not crash in one spot like an airline typically does. Because it scattered over a large area, NASA depended on calls from locals to help them understand the size of what they faced. This was complicated initially because they received calls from people reporting debris from 50 states and 6 countries. The magnitude of this operation was enormous. This became a complex puzzle. It took time, structure and tremendous tenacity to capture its primary boundaries, which ended up extending from Fort Worth, Texas to the western side of Louisiana. With the help of computers and people like John Grunsfeld and Scott Horowitz, NASA slowly got its arms around the Columbia's debris field which extended 220 miles east to west and 10 miles north to south. Once these boundaries were defined, the 2-mile by 2-mile grid system got laid out and the search process gained the additional structure it needed to coordinate a large-scale search effort. With the help of the Incident Command Structure, well-trained forest service workers carefully walked these two square mile grids. What began as search lines of volunteers and forest service professionals sometimes stretching as far as a quarter of a mile with over 80 people gradually shifted into skilled ICS teams with organized line searches of 20. With this structure organization and efficiency evolved.

The Incident Command System (ICS) provided a structure large-scale efforts can use and rely upon in the future. Besides being an invaluable labor resource, the planning, logistics and organizational expertise were of profound assistance in this recovery. Its commanders were trained in ways that might benefit NASA's next generation of senior managers and leaders. Use of structure in training models provides consistency and supports the quality it takes to develop talent. Unless the agency takes an assertive proactive stance in developing this talent, it will have to rely on unexpected circumstances like this tragedy, to experientially grow its membership.

10. Positive Relationship Skills

Strong, positive relationships between people and organizations contributed to this operation working "seamlessly", a Lufkin reference of how well people worked together. Having close working relationships became a core value that added efficiency and capability. Positive relationships improve communication, organization, innovation and solution based thinking. They also buffer burnout and exhaustion by adding critical support. This was especially important because of the long emotionally draining workloads and extended time away from home.

It was the relationships established between people and organizations that made communication work and provided the foundation from which creative solutions to difficult problems were found. Relationships are an outcome of influence. When one has the ability to influence others, a relationship is formed. Throughout this recovery effort, people in positions of leadership asserted great influence on the people working with them and for them. It created a highly responsive situation with extreme loyalty to the relationships shared. This was seen on a one on one basis, in small groups and on a large scale between the state and federal agencies in Lufkin, the four Base camps and their senior leadership in Washington and Dallas.

Dave King, Lufkin Director of Field Operations (DFO) was a great example of someone whose relationship skills made a huge difference. Taking off from Huntsville airport on February first, he had no idea where his plane would land, what he would be called to do and whom he would have as teammates. His team evolved from a diverse group of talented people he was given to work with. He used his relationship skills to bring them together and create a team. He learned their capabilities, defined their roles and responsibilities, freed them up to use these capabilities and when necessary, corrected their course of action. Because he took the time to establish good relationships early on, he was able to ask them for what he wanted and confront them when necessary without fear of losing their involvement and get whatever was needed to solve problems. He was open to trust and to trust freely. However, people had to honor this trust to continue getting it. This delegation of responsibility gave him the time to do strategic thinking, accurately scope out what was needed and then solve the problems they faced.

From the very beginning of this tragedy, relationships played a significant role in how well the agency functioned internally and how they were perceived by the outside world. During the first week of press conferences, Ron Dittemore, the Shuttle Program Manager, established a relationship with the American public by effectively communicating NASA's concern with genuine openness and honesty. It was a connection that greatly served the agency and the healing everyone needed. Sean O'Keefe's relationship with the White House and Congress provided the support NASA needed to focus on solutions rather than blame. It was an invaluable relationship that fed the relationship NASA had with the families of the crew. The families provided NASA's leadership uncompromising strength and conviction to move forward. A poor relationship would have greatly added to a different outcome. The role relationships played in the recovery is as important as the relationships now needed between programs, centers and contractors. The importance of these skills and the relationships they foster cannot be overstated.

All three Directors of Field Operations in Lufkin, Dave King, Mike Rudolphi and Alan Flynt, all gave NASA great examples of leadership built upon the power of positive relationships. They connected with the people they depended on. Their passion to help others became an energy that sustained other people. They inspired excellence because they valued excellence personally.

Mediocrity, indifference and complacency were simply unacceptable. They were accountable so they were able to expect accountability from others. In spite of their differences in style and personality, they all were successful. The rank and file adjusted to these differences and committed to who ever was DFO that week. It was a respect given because of the relationships established. As leaders, they worked as hard as they needed others to work. Everyone's hands got dirty doing whatever the mission required. Like a revolving door, power was given and power was given back. These were leaders who made the people around them feel great. With no room for ego, they used the relationships they developed and their team of loyal advisors, workers and volunteers to find the seven astronauts and an astonishing 40% of the Shuttle.

11. Energy Management

Energy management is a conscious attempt to either conserve energy or replenish it. Although people shared a connection during the recovery effort that boosted energy, the on going demands of the first month proved to be extremely depleting. This depletion increased the risks of burnout, exhaustion, illness, arguments and mistakes. Smart health care behavior such as getting enough sleep and taking needed time off compensate for extreme work demands by replenishing energy. As the effort progressed, health care and energy management improved. NASA's rotation of personnel helped. However, the greatest success in energy management was when Space Flight Awareness started using astronaut guest speakers to boost the morale of forest service walkers. These evening sessions took over a month to begin but were invaluable rewards of energy. As a lesson of this exercise, effective ways of boosting morale and replenishing energy need to be studied and implemented throughout NASA.

During the recovery effort the first several weeks required extremely long hours, coupled with intense and emotionally draining challenges. Although leadership took responsibility for the care of those underneath them, their own self-care was equally important. It was a challenge. In circumstances like this, a balanced normal life is not possible, all the more reason why commonsense health care and energy management is essential. People need at least six hours of sleep, visits from a spouse on weekends or time to return home and get grounded doing something other than work. This simple care needs to be enforced to ensure against the burnout that adds to an effort's problems. People can get too close to their work or the importance of their work and not take care of themselves. Worse, they fail to recognize this when it happens. Reinforcing simple exercise, weekends off, time with friends and family, down time and recovery time is the essence of energy management. The object is to make sure people have the energy they need to do what's required and to rebound from work overloads.

Maintaining worker morale was also a key part of energy management during the recovery. Space Flight Awareness did an excellent job with the help of the astronaut office in converting dead time during evenings into energy building and morale boosting sessions for the searchers. This was a good example of what is gained from giving back to the people who were giving of themselves to NASA everyday. It was imperative that the agency appreciated, in tangible ways, how grateful they were for everyone's contribution. People gave because they felt like valuable members of the NASA team, a team they felt great pride belonging to. Learning how to raise the pride of NASA's own employee's to encourage the commitment they are called to make will be more of a challenge.

Giving was a cornerstone of the human spirit witnessed in east Texas. What NASA was given by countless people provided limitless energy to the people who endured this effort. It is through the serving of others and the giving of our selves that join forces and change people. Many people left this recovery with a renewed energy about life. This energy will affect them professionally as well as personally.

Deep roots were grown because of this tragedy. These are the roots that feed our capacity for magnificence. These are also the roots that help people heal and endure. As NASA infuses the lessons of the Columbia recovery into the soul of the agency, it must commit to the accountability awareness depends on. Learning is tested by the change it forces. NASA does not improve by staying the same. It has more to learn and do.

> "To have vision is one thing, to make it happen is quite another.
> It is this second part that makes us extraordinary." Dave King

III: The Lessons from the Oral Histories

These are lessons that were offered by various parties during the oral histories. These were grouped to provide a sense of how these lessons were perceived.

FEMA

- "We don't realize the capability of other agencies (and need to)."
- "Operations like this begin by identifying top objectives and then prioritizing them. All lead agencies must share ownership. The hardest part, however, is winding everything down (the end not the beginning)."
- "Although telecons are necessary to keep people informed, visits from our headquarter representatives are what we prefer because it keeps them more involved."
- "Keeping people is a challenge during the fast, long and chaotic demands of the first two weeks working 16 hour days."
- "Data is a huge challenge. We started with several databases and needed to quickly merge into one." (*Future efforts would be served if there were one primary database shared by all key agencies from the very beginning of an operation. This is a critical lesson for Homeland Security.)
- "Good coordination means lower conflict. FEMA's responsibility IS to coordinate (keeping conflict at a minimum). When it does arise, FEMA is the referee."
- "NASA thinks out of the box. (They figured out how to solve problems as needed.) This really helped us"
- "Early on we need a Host Agency Briefing to explain acronyms and the response team system/organization (i.e. MIT means Mishap Investigation Team not a university in Boston which is what we thought every time we heard it used)."
- "FEMA is best as a recovery agent. If we are going to continue to be used in non-natural disasters, we need to become a response agent and move from planning into real time operations. (Operational experience and expertise is invaluable in situations like this)"
- "Ego problems need to be addressed. FEMA typically fights with other agencies in the early stages of a disaster, like newlyweds learning how to work a marriage. (This didn't happen here).

NASA Director of Field Operations (DFO)

- "HQ supported us but stayed out of our way".
- "We can give people what they need to be empowered but they have to act on it and make it happen."
- "As a site guy, I felt responsible for people's care. We talked a lot about self-care but when adrenaline kicks in passion takes over. It's easy to abuse and won't know we've done it until it's too late."
- "FEMA was excellent. They used their acquisition authority and got the equipment & contractors we needed. Because disasters are usually unique in nature, we must train for the unexpected (i.e. re-entry never caused death before). We must allow time for people to settle in and let structure to form, getting past the initial emotion and beyond "turf". FEMA came in "asking" not telling and it really helped."
- "We need to strengthen the civil servant role"
- "We need to grow curious minds, now."

- "Rotating people back home between centers like we did with the DFO's in Lufkin will provide people with useful differences in perspective but it must be of real value not just an exercise in checking a box."
- "We must deal with helplessness of those not involved in East Texas."
- "It's important to pull together the primary agents of this recovery and draw out our collective lessons."

MIT (Mishap Investigation Team)

- " The biggest challenge is getting structure setup."
- "Information management needs revisited, such as when and how we ran some of our telecons."
- "Our database was a huge problem and a big challenge to pull together."
- "The role of Dave King, DFO, served a purpose in this accident because of the magnitude of the operation. I question whether this job will be needed in a smaller scale event."
- "With a telephone in each ear and people on each side asking questions, early structure is needed to decrease chaos and get us out of the react mode. Once the structure was created and took over I was hardly needed."
- "Taking responsibility was key to our effective leadership. The Forest Service ICS commanders were awesome as was Scott Wells with FEMA. He was measured and structured and proved to be very good."
- "Ground and air operations, all goal oriented Type A people, worked 12 hours a day or longer, then would go to camps and sign photo's for the walkers until late at night and come in the next morning with a smile on their face. This was real step up."
- "Because public safety was our first number one priority, the decision to treat all debris as potential Haz Mat was a good one, even though it taxed resources."
- "KSC's hands on type of support worked extremely well."
- "The MIT needs taken out of the program office."

Texas Forest Service

- "There is a need for organized structure and planning, sooner in the operation."
- "It is essential that people leave their egos at home."
- "There is a need for an assertive command presence early in a situation like this."
- "We need to worry more about doing the right thing, than being right."
- "Standard actions bring formality and structure in an incident. One of the worst things you can do is not inform people."
- "An IAP (incident action plan) needs developed and communicated the first night. (I.e. who's who and what do they do) If, as in this case, there are commands in two sites, Barksdale and Lufkin, this must be shared in each to track information and people."
- "We need to look at different ways to sell ICS (our structure and capability)"
- "When expertise is not initially accepted or understood, find other ways to contribute."
- "We need a compatible database and ideas on avoiding redundancy."
- "We need a mechanism for communicating concerns and disagreements. If we had this we could have gotten to ICS sooner."
- "We need to ensure adequate personal time for people."

EPA

- "We need to make sure we are staffed properly for multiple terrorist attacks."

- "We need a compatible data base and data management. There needs to be one person in charge of data management for each agency."
- "Lesson number 1 on every disaster is communication. We need to be thinking ahead of cell phone access and Internet access."
- "Lesson number 2: We need to put teams together and work out conflicts between HR and Haz Mat before the next future situations. (FBI and EPA)"
- "Lesson number 3: We need to set up ICS as soon as possible"
- "Lesson number 4: We need pyro information (hazardous commodity) right away. NASA did not share pyro information in Lufkin. If this was done at Barksdale, it was not shared at Lufkin."
- "Lesson number 5: We need to consider ways to utilize NASA in future situations. (Knowledge, expertise, assets, database, operational structure, management out of box innovative thinking)."
- "Lesson number 6: The common goal in this incident helped us work together as a team. Usually there is a lot of spiff between groups. Some of these differences fester for years. Perhaps because NASA was a new player that kept this from happening and made this a positive experience."

NASA Astronauts

- "Three things must be done right away:
    1. Activate a command center
    2. Locate people and assets
    3. Gather intelligence. It's best to gather intelligence before you develop The Plan."
- "In earliest stage, people who showed initiative got the job. People who came expecting to perform a function were not helpful. People willing to do whatever we needed were."
- "One leadership lesson is to find people who know what they're doing and let them do it."
- "We leaned on previous training to keep emotions locked in a box. To be successful in finding the crew, we needed total tunnel vision."
- "GPS data entry needs to be accurate with correct units, properly acquired (45 seconds to lock on). We need a standard GPS (like WGS 84)."
- "FEMA is best at coordinating. They do not do quick field operations. FEMA was a planning organization not Ops."
- "Sharing turf depends on sharing mutual respect of expertise. When we went to EPA and asked to negotiate Haz Mat policy, they said "sure". The same respect was shared between NASA and the FBI in the HR recovery. The FBI's structure and detailed report really helped us."
- "Long late night meetings after long draining days became an issue."
- "HQ allowed us to execute. General Kostelnik said, "You make the call, I'll back it up." This made a difference."
- "My wife coming for the first weekend helped her and me (self management)."
- "We had to make tough calls like turning down 700 volunteers. We already had too many people and not enough structure."
- "Field site visits add to command center awareness, leadership and situational awareness."
- "Once we defined the search area and limited corridors, we improved."
- "Smaller search teams in better shape were able to do more faster."
- "There was a need for sleep. Ambien helped. We needed to watch out for fatigue and have an advocate for rest."
- "There was a need to take care of our families as well as our selves."
- "FEMA's control over all finances was critical to this working."

- "We need to apply the lessons learned to OSP. The only thing that survived was spherical tanks."
- "Initial reports are often wrong."
- "Looking at some of the hardware can be as traumatic as the HR (Post Traumatic Stress Problems)"

NASA Bruce Davis – data base

- "We needed compatible databases."
- "Look at the plan for responses to incidents and make sure they have the right technology and people to manage them. These must be coordinated between federal agencies. (GIS and Remote Sensing need incorporated in Federal Response Plan)."
- "Biggest problem with data is data entry."
- "You need to pick a response plan that offers inter-operability. At least two different GIS were used. FEMA used standard GIS. NASA used "ARC info" from ESRI; this huge company uses a number of different databases, which allows for easy sharing of data. Regardless of which system is used, a centralized system to enter data, to tag debris, to get over firewalls and to communicate must be chosen."

Space Flight Awareness (SFA)

- "We need to consider ways to motivate people (ground troops and emergency response workers) in high stress or long duration incidents."
- "SFA was successful because we lived and worked on site and because we were able to use astronaut visits, NASA photo's, pins and patches as a tangible and timely thank you and morale boost."
- "What will it take to reenergize troops in future incidences?"
- "How will we share this experience with those that did not experience East Texas, those back home with out making them feel left out?"

NASA Shuttle Program Office

- "Knowing what isn't said in communication is as important as what is said."
- "We each need independent strong convictions. However, because we cannot change the convictions of other people or companies, it's important that we understand them. Convictions becomes a liability when we stop listening."
- "Successful programs must go beyond the personalities of its leadership. Trust must be built."
- "Media exposure is an important lesson to develop. Having media experience really helps."
- "When is learning new lessons useful and when does it add to a sense of fault and blame."
- "Inherent distrust between civil service and contractors is contrary to the performance and relationships we depend on. Return to flight depends on clarification or roles and responsibility and a sense of shared accountability."
- "We need to decide if the Space Shuttle Program is operational or developmental."

NASA HQ Senior Leadership

- "Don't get hooked into any one theory. See the big picture."
- "State what we KNOW not what we think we know. Get ahead and stay ahead of the media as much as possible by being open and honest and giving them advance notice on whatever we can."

- "We need 'on the scene' federal coordination not in the MIT or contingency plan."
- "Being willing to question decisions about to be made was the key role of one senior advisor to Sean O'Keefe, Paul Pastorek who said his job was to support Sean not 'go along' with every decision or idea."
- "Sean was good because he focused on the future not the past."
- "This was not about looking good but about being good."
- "How insightful of Sean to share the contingency plan with the Navy, shortly after being appointed the head of NASA, for the purpose of gaining ideas on how to upgrade it. NASA did a full simulation of this upgraded plan in November, several months before it was needed for the Columbia incident. It pays to be prepared."
- "We benefited from our positive relationship with the crew families."
- "We need to grow our people, stretch them and create holes if need be to give them experience elsewhere."
- "The centralized data release system–CART- needs to be willing to use outside experts. The MRT needs to 'look' more objective by not looking as part of us."
- "We need to learn from our strategic communication efforts, how we were perceived by the American public, Congress, the media, etc."
- "We need to keep seeing the big picture so we don't walk over any cliffs."
- "Telling the truth was not only right because it got us the right results, it was the right thing to do."
- "SFA has been great in the field."
- "We came out right in front – said as much as we knew – as often as possible and owned responsibility for what was necessary. Our job was to find what went wrong, fix it and fly again."
- "ICS management and leadership is something (NASA) can learn from."
- "SFOC needs more government penetration perhaps changing from cost incentive to performance incentive."
- "FEMA was extremely successful facilitating and coordinating this incident."
- "The future of NASA will depend on maintaining the government and executive management skills, witnessed during this event."
- "There were communication benefits gained from the open setting of the civic center."
- "There were many non-government agencies that significantly contributed to our efforts. McDonalds, Walmart and the Salvation Army (to name a few) all gave so much without wanting anything in return. We need to consider ways to show them our appreciation."
- "The after action plan was as important in putting together as the decisions made in the beginning of the recovery effort."

Miscellaneous

- "How can we counter the physical effects of the air operations?"
- "We needed more waterproof boots, especially for those who searched in their own. Boots sold at the camps needed to be priced at 'Wal-Mart' prices."
- "Driving back and forth to Lufkin was killing folks especially after long stressful days and early morning briefings."

- "It was overwhelming the amount of supplies that had to be purchased. We needed better control systems because too many folks were ordering."
- "Logistics needs to include communicating with volunteers like those trying to plan meals in Hemphill."
- "PAO was never at Hemphill during the HR recovery."
- "How does the general public contact NASA?"
- "Texas State Troopers – DPS- searched everyday in their "class A" uniforms. They had no waterproof boots or chaps. They buy these uniforms themselves and many were ruined."
- "Local roads were really beat up and private fences destroyed during the search effort."
- "This was no accident that the Columbia and its crew came down in east Texas. Between our small town patriotic attitudes, our strong faith and our commitment to serve, we were the right people to find the astronauts and shuttle."